

for scattered papers and lectures, but can find in the volume before us a *résumé* of his inquiries, with some additional information, as well as a list of works, old and new, which deal with some or other of the topics discussed in Dr. Laurie's pages. This list occupies nearly fifty pages, and is comprehensive if not precisely exhaustive.

Of the fourteen chapters into which this handbook is divided, not the least important is that which forms the introduction, in which a sketch is drawn of the interdependence of certain crafts, of the development of the processes of painting, of the increase in the number of available pigments, and of changes in the workshop and studio. Then in six successive chapters there are described Egyptian pigments and mediums, and classical methods, such as wax-painting, egg-tempera, and a kind of fresco-painting. The eighth chapter deals with the later history of fresco-painting, and then comes a series of discussions based on the treatises of the monk Theophilus and on the "Book of the Art," by Cennino Cennini. By means of abundant quotation from these authorities and by original comment, Dr. Laurie has certainly succeeded in reproducing "the atmosphere" described in the preface as that "in which these ancient works were carried out." As our author never loses his hold on modern science and modern practice, we commend his appreciative sympathy with the naive descriptions and utterances of the older writers and historians of art.

"On the painting of illuminated manuscripts" is the heading of the eleventh chapter. There are here some indications of the pigments used in such wonderful productions as the "Book of Kells," and the "Lindisfarne Gospels," both of the seventh century. For instance, we learn that "the Irish monks had learned to extract the purple dye from a species of murex found on the shores of the Irish Channel." Besides Tyrian purple the early Irish illuminators had at their command red lead, several ochres, a green identical with malachite and several lakes. The ink they used is supposed to have owed its blackness entirely to carbon, but a close examination of the writing in the "Lindisfarne Gospels," recently made by the reviewer, indicates, by the presence of a multitude of reddish-brown spots, the employment of a gallo-tannate of iron, like that described by Theophilus. To the subject of lakes and other "adjective" colours, as used in ancient practice and in mediæval days, Dr. Laurie devotes a chapter of twenty-five pages; the employment of dyed cloths as sources of some pigments, as in the case of the red from kermes, or *Coccus ilicis*, is described.

The last two chapters in the book are mainly given up to the study of questions connected with the origin of oil-painting, the making and use of varnishes and the preparation of pigments and of canvas-grounds during the sixteenth and seventeenth centuries. Dr. Laurie admits that he is unable to pronounce definite judgments on all disputed points, but he has certainly contributed valuable material for a solution of some of the problems offered by pictures supposed to have been painted in oil during the fifteenth century.

In the volume under review are included thirteen illustrations, many of them in colour. They are not

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merely pleasing enrichments of the text, but serve the purpose of throwing light upon certain descriptive passages.

On the whole, we may consider that the aim of the author has been satisfactorily accomplished and that he has given, within reasonable compass, a fair account, in English, of the varied information scattered very widely in the literature of the art of painting.

In a second edition the author must correct a few slips. For example, the two great lunettes painted by Lord Leighton in the Victoria and Albert Museum are not in true fresco (p. 136), but in spirit-fresco, an oleo-resinous vehicle containing wax. Again, Dr. Laurie has misplaced (p. 334) the Christian names of the brothers van Eyck. Revision is needed elsewhere also, as in the recommendation to use *terre verte* in true fresco-painting (p. 137); it has proved very treacherous in this country. Then, too, the attribution to Mr. James Ward of the "valuable suggestion, unknown to the older painters, namely, the introduction of asbestos into the plaster to bind it together" (p. 138), does not fit the circumstances. Mr. Ward in his "Fresco Painting," published in 1909, does, it is true, recommend this use of asbestos, but it had been so employed long before, and its adoption had been urged nineteen years previously in a well-known technical manual.

A. H. C.

THE COLLOID STATE OF MATTER.

Kapillarchemie, Eine Darstellung der Chemie der Kolloide und verwandter Gebiete. By Dr. Herbert Freundlich. Pp. viii + 591. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1909.)

THE attention which has been directed during recent years to the colloid state of matter has led to the publication of a very considerable literature, and the subject is rapidly becoming an important section of physical chemistry. We therefore welcome Dr. Freundlich's book as perhaps the most complete attempt to deal with the subject as a whole on the lines of a definite hypothesis, and bring it into clear mathematical relation to physics.

The colloidal state is usually, and possibly always, a two-phased condition, in which one finely-divided substance is suspended in another, and ranges by imperceptible gradation from such suspensions as clay in water or butter-fat in milk to true molecular solutions which to our present means of examination are absolutely homogeneous. In such systems the surfaces of contact between the two phases are of enormous area, and the phenomena of surface-action and especially of surface-tension have an importance of quite a different order to that which they possess in single phases. Dr. Freundlich, indeed, is inclined to consider them essential causes, not merely of the peculiarities of colloid solution, but of adsorption, coprecipitation, and electric cataphoresis, which often bear the closest resemblance to ionic chemical reactions. While, however, the influence of surface or surface-action is the guiding hypothesis of Dr. Freundlich's work, we have been particularly struck with the candid and truly scientific spirit in which he admits its limitations, and states opposing views.

Beginning with a discussion of the mathematical work of Laplace on surface-tension, the author points out that while it adequately expresses the effect as observed on curved surfaces, it gives no explanation of tension on plane ones, since it assumes the internal pressure to remain constant to the surface and to react vertically to it only. A more complete theory has been developed by van der Waals and his pupils. In the gas-equation, $(P + a/v^2)(v - b) = RT$, the a/v^2 represents the increase of pressure due to the mutual attraction of the gas molecules; and this, while only a trifling correction in gases, becomes an enormous pressure in liquids owing to the closeness of the molecules. When, however, a particle lies actually on the surface, it is only attracted by those below and around it, and not compressed by others above, so that the surface-layer is not only under a much lower pressure vertically, but the surface is under actual tension from the horizontal component of the attraction of the particles around and below it. Since the liquid particles not only exert attraction on others in the surface-layer, but on those of vapour or gas immediately above it, it is clear that the layer of rarefied liquid must pass without break into a layer of compressed vapour within the very small range of molecular attraction. Substances, like most salts, which dissolve with contraction of volume, increase of internal pressure, and diminution of vapour-pressure, also increase the surface-tension, while volatile liquids and many colloid organic substances diminish it.

It was first pointed out by Willard Gibbs, and afterwards, more fully, by J. J. Thomson, that bodies which diminish the surface-tension must tend to accumulate in that surface, while the reverse is the case with those which increase it. Freundlich sees in this the explanation of adsorption, positive and negative; and as such an effect on surfaces even between liquid and vapour can be shown experimentally to occur, it must be accepted as one of the causes, though whether it plays the important part which he assigns to it must remain uncertain until means are found at least of estimating its quantitative effect. Lagergren has suggested another physical theory of adsorption based on the idea that a surface is a region not of tension but of compression, and that substances which favour contraction of volume must accumulate there. While it seems impossible to accept the idea of a compressed layer at the surface of a liquid in contact with gas, it may well be that the liquid is compressed, and its surface-tension negative on solid surfaces, just as van der Waals assumes that gas is compressed on liquid ones, since the internal pressure and surface-tension of solids must be enormously higher than those of liquids. Neither theory adequately explains many of the individualities, both of absorbent surfaces and adsorbed substances, some substances being adsorbed at surfaces both of positive and of negative surface-tension, and one is inclined to believe, what indeed Freundlich admits, that chemical forces often come into play, and that adsorption resembles in many cases a sort of contact-solution of two bodies having chemical affinities, or, what is probably the same thing, opposite electric potentials.

H. R. P.

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TRAVELS IN ICELAND.

Island in Vergangenheit und Gegenwart, Reise-Erinnerungen. By Paul Herrmann. Teil iii., Zweite Reise quer durch Island. Pp. x+312+map. (Leipzig: W. Engelmann, 1910.) Price 7 marks.

THIS volume, although complete in itself, is a sequel to the two parts of "Island in Vergangenheit und Gegenwart" (1907), describing Herr Herrmann's travels four years previously. As before, the town of Torgau allowed him the long leave, provided a *locum tenens* (as schoolmaster), and relieved him of all anxiety during the illness resulting from an accident on the journey. The money was provided for the undertaking by the higher educational authorities, and we cannot wonder when he observes, "Surely few towns would act so munificently." The same guide was employed—he who accompanied Thoroddsen on his explorations—but although the surrounding circumstances were equally favourable, the book does not give quite such an impression of enthusiasm for Iceland in each and every aspect as on the former visit.

The route was by sea round the eastern, western, and northern coast, descriptions being given of all places called at, and the scenery passed. Herr Herrmann is pleased to think his former books are used as reference by tourists, and this part of the present work is specially for their benefit. He thinks the number of visitors will greatly increase when the steamship service is improved. He complains greatly of the accommodation now provided, and quotes and agrees with the opinion of another traveller (O. Komorowicz) "that if such were used in Germany for the transport of animals the S.P.C.A. would interfere!"

From Reykjavik the journey as far as Uxahryggtr was over familiar ground, but a new route was struck thence to Kalmanstunga—with an excursion to the Surtshellir caves—and westward round the Snæfellsnes peninsula, where the inhabitants were not found as lacking in progressive spirit as from other accounts was expected. Northward to Hrofberg with an appreciative allusion to the agricultural school at Olafsdalur. Then eastward to Hólar, the seat of an ancient bishopric and present agricultural school, and southward over the Kjolur to Geysir.

When the disadvantages of storms, cold, tent-life, and many minor catastrophes were overcome, and the pleasant neighbourhood of Hvítárvatn reached, an attempt to visit Frodardalur resulted, owing to an overtaking storm, in a severe fall from the pony. As a result of this accident the remaining portion of the journey, by Skalholt, Gullfoss, and round Reykjanes to Reykjavik, is undertaken with less spirit.

The author enlarges more on the geological aspect of the country than in the preceding volumes; in the meantime he has learnt much in this direction, but wishes the scientific reader to remember always that the descriptions, remarks, and conclusions are those of a layman only. The more he knows of Iceland the more his admiration of Thoroddsen, as a geologist and explorer, grows, and this appreciation is expressed in many references.

For younger geologists the entirely or partially